Socioeconomic influence on mathematical achievement

What is visible and what is neglected

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SOCIOECONOMIC INFLUENCE ON MATHEMATICAL ACHIEVEMENT: WHAT IS VISIBLE AND WHAT IS NEGLECTED

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The survey team worked in three areas: Literature review of published papers in international publications, particular approaches to the topic considering what in the literature seems to be neglected, and opening a discussion among researchers and teachers about how they understand this topic in their contexts and practices. In this paper we offer a synoptic overview of the main points that the team finds relevant to address concerning what is known and what is neglected in research in this topic.

Poverty, early childhood, intersectionality of positionings, statistical reifications, macro-systemic perspective, history of mathematics education practices.

INTRODUCTION

It is known in mathematics education research that socioeconomic factors have an influence on mathematical achievement. It would not take a big effort to summarize the studies that both at national and international level establish a connection between what may be called “the socioeconomic influences” and what is called “mathematical achievement”. Nowadays such link has become almost commonsense, that is, an idea that everybody refers to and knows, and that has become part of the “facts” that researchers, teachers, administrators and politicians have at hand: “the better off you —and your family— are, the more likely you will do well in school, including mathematics”. Such a statement embodies its opposite: “the worse off you —and your family— are, the more likely you will do poorly in school, also in mathematics”. While studies arguing for the connection between people’s social and economic position and condition and school achievement emerged at the beginning of the 20th century, for many years the specification of the relationship for school mathematics was not enunciated as a problem for society or for research. It is only in the 1980s when the broader concerns of mathematics education and social, cultural and political issues started to be a focus of attention of the community of mathematics education researchers. What is known so far —which may be part of the commonsense understanding of the topic— and what seems to be forgotten —which may be the critical readings that challenge the commonsense— were the central questions that have guided the work of the survey team.

As a team examining this topic for ICME 12 we defined three main tasks for our work. First, we were interested in providing an overview of the research available and its findings. Second, we wanted to point to the shortcomings of the existing research by bringing together a variety of readings of the international and national literature, coming from the diversity of research topics that constitute the core scholarship of each one of the members in the team. Third, we wanted to open a communication with other colleague researchers and teachers in different parts of the world about the meanings and understandings of the "socioeconomic influences on mathematical achievement" that circulate in practice. For that purpose we opened a FaceBook group that for some months invited people to contribute with their written work, as well as with images that captured their interpretations on the topic of the survey. This allowed us to have a broader information basis and a range of opinions and debates about the topic.

We formed an extended team with colleagues who contributed with reflections and insights from their own contexts. We want to thank Alexandre Pais from Aalborg University for his support along the work of the team, Arindam Bose from Tata Institute of Fundamental Research in India, Francisco Camelo from Bogotá's Capital District University "Francisco José de Caldas" in Colombia, Hauke Straehler-Pohl from Freie University in Germany, Lindong Wang from Beijing Normal University in China, and Troels Lange from Malmö University in Sweden for their contribution and support to the team.

In this paper we report briefly on each of the three areas in which the team worked, bringing to the international community an overview of what is visible and what is forgotten in the field concerning the socioeconomic influence on mathematical achievement.

WHAT IS VISIBLE

A global literature review for this topic poses challenges such as the multiple languages in which research reports are made available, as well as the access that we as a team have to these languages. Therefore, we tried to gather literature that would indicate some trends in what is known about the socioeconomic influences on mathematical achievement in different parts of the world, and unfortunately most of what was reviewed was published in English.

There are two levels of discussion that become important for this topic. The first level has to do with the existence of general educational reports, and the second level with mathematics education research literature. At the general educational level, the relationship between socioeconomic factors and school achievement is inserted in the history of expansion of mass education systems and differential access to education around the world during the 20th century. Meyer, Ramirez and Soysal (1992) show that the consolidation of Modern nation states is correlated to the expansion and Modern organization of mass systems of education. The constitution of nation states was characterized by a focus on socialization of as many individuals as possible to become members of society, with a secular vision of progress in which science and rationality were articulating elements. The state provides an increasingly regularized and standardized curriculum, and it establishes the link between personal development with the mastery of the curriculum, and such mastery of individuals to the progress of the nation. Even if countries such as Japan, China and Korea, as well as some of the Arab states aligned to this cultural model in the 20th century, nowadays there seems to be little divergence on the overall cultural Western model and rationality behind the organization of school systems. With the expansion of mass education, the issue emerged of who has access and on the grounds of what. Discussions on modernization attached to the Post Second World War started emphasizing education as a strategy of human capital growth. To know who was having effective access to education became important. However not all countries had statistical information on school achievement, and even some of the statistical tools for making strong arguments about the connection between education and achievement had not been developed. The report "Equality of Educational Opportunity" best known as the Coleman Report (Coleman et al, 1966) was one of the first large scale national surveys which sought to formulate a model to determine the extent to which educational opportunities were equally available to all citizens in the USA. The results were meant to be used for policy-making. The report allowed individual students' socio-economic, racial and ethnic characteristics to be connected to school inputs in terms of resources available to run education, and to students' individual performance in achievement tests. Internationally, the International Association for the Evaluation of Educational Achievement (IEA) started providing international comparative information about how different national curricula provide different opportunities to learn, and the existence of a lack of equity between different groups of students (IEA, 2012). Since then, the measurement of educational quality was moved from an input-output model based on school resources to an individualization of the measurement of educational quality in terms of students' achievement. Furthermore, the standardized tests given to children in the study included mathematics. This fundamental change in the general reports on educational access is central for connecting socio-economic influences with mathematical achievement.

From the previous comments it can be seen that the discussion on what may be the socioeconomic influences on mathematical achievement did not emerge from the core of mathematics education research, but from general social science research and educational research. Therefore what has become visible about the topic is found in general reports on educational systems around the world, as much as in mathematics educational research literature. The emergence of the connection between socioeconomic factors and mathematical achievement from sociology and economy of education reminds us that any talk about such a connection in the realm of mathematics is bound to general discussions about how educational systems generate disparities for different types of students. The phenomenon is largely located and generated in other realms of society, and it is not exclusively effected in mathematics classrooms. The point of connection between the boundaries of scholarship in mathematics education and the scholarship in the social sciences in general is illustrated in the particular perspectives that the members of the team adopted when opening up particular research areas.

Within mathematics education research the concern for this connection emerged as a research topic with the advance of the "social turn" (Lerman, 2006) since the 1980's. Following the general trend mentioned above, the studies that address this issue are mainly quantitative and to some extent large scale. It is important to mention that even if from the time of the Coleman Report and the first studies by the IEA —such as the First International Mathematics Study (FIMS) in 1964— it was possible to establish the connection. However, the amount of literature testing different hypothesis about such a relationship has increased with growing importance given to periodic, international, standardized, comparative studies such as TIMSS and PISA since the 1990's.

In general different parts of the world consistently produce similar results about a society's sense of expected, normal school achievement and how different groups of students are compared to that normal expectation. While in the USA, a factor that systematically generates differentiation to the expected norm is race, in other countries it is socioeconomic status as in for example the UK, Europe or Australia, or home language and ethnicity in the case of some European countries such as Germany and Denmark, or rurality as in for example China or many of the African and Latin American countries. Although other factors are also present, the tendency of countries to focus on one factor has influenced the way that discussions operate in these countries. In different countries the independent variables which are considered to be the socioeconomic influences on mathematical achievement —defined as the dependent variable— varies. This variation indicates what in a particular society differentiates types of people from the definition of normality which is formed from expectations constituted by the dominant groups of that society, at different points in time. This is to say that the discussion of what may be considered the 'socioeconomic' influences on 'mathematical achievement' depends on the systems of differentiation and stratification of the population, and is not any kind of existing, a priori characteristic of individual and groups of students or of mathematical achievement per se.

A second general observation in the studies is that, once the general differentiation is possible as mentioned above, the use of similar statistical indicators is adopted in the studies. Prior to the existence of international comparable, standardized national data sets available through the series of TIMSS and PISA studies and many other more specific international comparisons, the variable of socioeconomic status is one of the most used in the studies. Since its construction in the 1920s (Sims, 1930), the measurement has been composed by a series of reliable indicators —parents' educational level, family income, possession of appliances, possession of books, etc.— which have not changed very much in almost 100 years. What is interesting is that there is a tendency to simplify the measurement due to how difficult it is to collect reliable information on this matter from children. The effect of this fact becomes that the assignment of a socio-economic level to individual students often takes place on very thin evidence. The effect of the measurement, on the contrary, has the tendency to reify a solid state that follows individual children all through their school life. This reification has been documented in studies that have addressed how the discussion of students' differential results is dealt with in the media (e.g., Forgasz & Leder, 2011) and in public discussions among parents (e.g., Lange & Meaney, 2011).

A third general observation is that even if many studies have a tendency to establish the relationship between a limited number of variables indicating differential positioning, many studies conclude that those variables intersect. This means that students whose participation in school mathematics results in low achievement experience differential positioning in schooling because they are attributed simultaneously several categories of disadvantage. For example, low achievement in mathematics in certain regions in China —such as the Western China (Hu & Du, 2009)— is explained by the intersection of factors such as rurality, parents' educational level, mother-at-work, and language. In other words, existing studies devise sophisticated statistical measurements to trace the factors that correlate to differential access to mathematical achievement. However, the very same statistical rationality on which those studies are based imposes a restriction for understanding how the complexity of the intersectionality of variables of disadvantage effect differential results in mathematics.

A fourth general observation is the fact that, in the existing literature, there is an over-representation of research reports addressing the socioeconomic influences on mathematical achievement in English speaking countries (USA, UK, Australia and New Zealand), while there is little and almost no existing research on this matter in many other places in the world. Such difference may not only be due to the extent of research in mathematics education in these countries, but also by the fact that in different places the differential achievement has not been construed as a problem. In East Asia there is little research in mathematics education investigating those who do not perform highly and why. Few recent studies in general education in China address the issue because, like many other large-scale studies, students' results in mathematics are part of the data on school achievement (e.g., Li, Ni & Li, 2011). In countries such as Taiwan research identifying background information on students to relate with their achievement discards the focus on socio-economic variables and privileges variables such as student's learning goal orientation (Lin et al., 2009). The argument for such a choice is the fact that the documented correlation between socioeconomic status and achievement is beyond the control of educators; therefore it is more meaningful to study and understand variables that educators can impact positively to improve results. In relation to South Korea the quite differentiated achievement between students of different socioeconomic status is explained not as a result of economic resources of the schools to which students attend, but rather in terms of the possibility of buying private tuition. Access to private tuition reflects a difference in resources among people that educational policies cannot compensate for. The practice of private tuition is deeply rooted in the Confucian view of education and effort, but also in the great differentiation of access to prestigious higher education (Kang & Hong, 2008).

In India, Bose (2012; Bose & Subramanian, 2011) has been crossing the boundary of the stark divide between rich and poor in Mumbai. Some studies have tried to argue that differential achievement in school mathematics is due to students' mathematical aptitude, gender and urbanity/rurality (Sethi, 2011) as well as the socio-economic and cultural characteristics of communities (Chudgar & Shafiq, 2010). Some other studies have emphasized the impact of child work for the lower castes and poorer communities (World Bank, 2009). Bose addresses the possibilities of children learning mathematics in the relationship between out-of-school, work practices and school mathematical practices. The understanding of children's sophisticated mathematics competencies in the context of children's participation in work provides a perspective that goes beyond the interpretation of the children as unfit to succeed in school due to the school high demands and their low ability. Bose (2012) concludes that real-life experiences shape the way children from such localities think and perceive mathematics. For them, the rules of mathematics are not rigid, but flexible depending upon the situation: "The sharing need not be equal for them and division need not be fair. Here comes a disconnect between what children study in schools and what they see and experience in world outside" (Bose, 2012, p. 11). Contrary to research that simply "proves" that poor underprivileged children do not achieve, this research shows that the better understanding of what these children are good at may actually be useful for the teachers to draw upon and take forward for effective mathematics teaching and also to introduce newer concepts.

Existing research both in general education and in mathematics education has constructed the positive correlation between a lower positioning of groups of students with respect to the valued norm of societies, and the results of the school mathematical experience measured in terms of achievement. Poverty, rurality, ethnicity, gender, language, culture, race, among others, have been defined as the variables that constitute socioeconomic influences on mathematical achievement. Many research reports discuss the fact and illustrate small variations in the overall logic of differentiation. The question remains whether it is possible to interpret the meaning of "socioeconomic influences" and "mathematical achievement" in ways that allow us to go beyond the facts established in the last 50 years of research. In the following sections each one of the members of the team offers a perspective on this issue.

WHAT IS NEGLECTED

Paola Valero on Historicizing the emergence of differential access to mathematics education

I am interested in discussing the historical conditions that make it possible to formulate the "socioeconomic influences on mathematical achievement" as a problem of research and practice in mathematics education. My guiding question is how and when the problem has been made thinkable, up to the point that nowadays it is part of the commonsense or taken-for-granted assumptions of researchers and practitioners alike. My strategy of investigation builds on thinking the field of practice of mathematics education as a historical and discursive field. I interconnect apparently unrelated areas in an attempt to shed light on the grid of intelligibility that makes it possible to fabricate the differential achievement in mathematics by students differently positioned as a social fact. Such rhyzomatic strategy (Deleuze & Guattari, 1987) allows me to point to the shifting connections that disturb the sense that students, parents and schools socioeconomic deficits exist monolithically and show up invariably in objective statistical measurements as causal to low achievement.

Education, Science and the Social Question. The social sciences and educational research can be considered as expert-based technologies for social planning. In the consolidation of

Modernity and its cultural project in the 20^{th} century, the new social sciences were seen as the secular rationality that, with its appeal to objective knowledge, should be the foundation for social engineering. The invention of statistical tools in the social sciences generates constructs that help in identifying the ills of society that science/education needs to rectify. This is an important element in how educational sciences address the differential access of different children to the school system. Constructs, such as students' "socio-economic status", later on expanded to school's and communities socio-economic status, emerged in the 1920's in a moment where the newly configured social sciences were addressing 'The Social Question'. That is, the growing problems with crime, poverty, alcohol abuse, sexual abuse, school underachievement, etc, of the growing population in urban centers caused by immigration and the urbanization of many other types of populations. In Europe and in other societies, the association between the religious and normative grounds of educational thinking and the emergence of educational sciences made it possible to articulate salvation narratives for facing the social problems for which education was a solution (Tröhler, 2011). Measurements of intelligence, achievement and socio-economic status were and still are technologies to provide the best match between individuals and educational and work possibilities. The double gesture of educational sciences of, on the one hand keeping a rhetoric for the importance of access to education, and on the other hand reifying difference by constructing them as a fact, inserts human beings in the calculations of power.

Mathematics and progress. The emergence of the connection between people's mathematical qualifications and social progress can be traced to the end of the 19^{th} century. During the second half of the 19^{th} century, mathematics teachers in different countries struggled to make mathematics part of the classic school curricula. Its place was relegated to vocational and military forms of education (e.g., Howson, 1974). During the second industrialization, a time of tremendous scientific advancement, the justification for the need for mathematics education was formulated: "The future of civilization depends greatly on the direction of mind that the new generations will receive in relation to science. Within the scientific education, the mathematical element occupies a dominant place. From the point of view of the pure sciences or from the point of view of the applications, the 20th century that is about to begin will place demands which nobody must or can avoid." (Laisant & Fehr, 1899, p. 5)

In the times of the Cold War, a similar argument emerged, however the justification was related to keeping the supremacy of the Capitalist West in front of the growing menace of the expansion of the Communist Soviet Union (Kilpatrick, 1997). Nowadays, professional associations argue that the low numbers of people in STEM fields can severely damage the competitiveness of developed nations in international, globalized markets (e.g., National Academies, 2007). The narrative that connects progress, economic superiority, and development to citizen's mathematical competence is made intelligible in the 20^{th} century. The consolidation of nation states and the full realization of the project of Modernity required forming particular types of subjects. The mathematics school curriculum in the 20^{th} century embodied and made available cosmopolitan forms of reason, which build on the belief of science-based human reason having a universal, emancipatory capacity for changing the world and people. The 'homeless mind' (Popkewitz, 2008, p. 29) that school mathematics has operated is a type of individuality where the subject is set in relation “to transcendental categories that seem to have no particular historical location or author to establish a home” (p. 30). In this way, subjects are inserted in a logic of quantification that makes possible the displacement of qualitative forms of knowing into a scientific rationality based on numbers and facts for the planning of society (Poovey, 1998) Thus, from the turn of the 19th century to present day, the mathematics curriculum is an important technology of the self that inserts subjects into the forms of thinking and acting needed for people to become the ideal cosmopolitan citizen.

Mathematics for all. That high achievement in mathematics is a desired and growing demand *for all* citizens is a recent invention of mathematics education research. In the move between the years of reconstruction after the Second World War and the Cold War, where school curricula was modernized with focus on the subject areas for the purpose of securing qualified college students (Thompson, 1959; Rudolph, 2002), mathematics education in the decade of the 1980s faced the new challenge of democratization and access. The “Mathematics Education and Society” session at ICME 5 is seen as the first formal session in an international mathematics education conference to have publicly raised the need to move beyond mathematical elitism towards inclusion of the growing diversity of students in school mathematics (Damerow et al., 1984). The well-documented systematic lack of success of many students in school mathematics was posed as a problem that mathematics education research needed to pay attention to and take care of. Mathematics education researchers, the scientific experts in charge of understanding the teaching and learning of mathematics as well as of devising strategies to improve them, gradually took the task of providing the technologies to bring school mathematics to the people, and not only to the elite. The idea of succeeding in mathematics as an issue of equity was made intelligible in a historical grid of events at the end of the 20^{th} century. The identification of mathematical achievement with the wealth of nations is a result, among others, of the growing series of reports that produced comparative information on educational achievement and development (e.g., Heyneman & Loxley, 1982; Baker, Goesling & LeTendre, 2002). Such reports can be seen as performances of the comparative logic of Modernity that operates differential positioning, not only among individuals but also among nations, with respect to what is considered to be the desired and normal level of development and growth. “Mathematics for all” can be seen as an effect of power that operates on subjects and nations alike to determine who are the individuals/nations who excel, while creating a narrative of inclusion for all those who, by the very same logic, are differentiated (Popkewitz, 2004).

I argue that it is on the grounds of at least these three elements that the “socioeconomic influences on mathematical achievement” has been enunciated as a problem of research in the field. By adopting the question of the conditions that make possible such problematization and performing my analytical move, I do not intend to say that being one of the persons who does not achieve as expected because of one’s differential position of socio-economic status, race, ethnicity, language, rurality, etc. is simply an unimportant “social construction”. My intention is to offer a way of entering into the problem that makes visible the network of historical, social and political connections on which differential social and economic positioning is related to differential mathematical achievement as a fact that has become taken-for-granted as commonsense.

Mellony Graven on Socio-economic status and mathematics performance/learning in South African research

South Africa's recent history of apartheid and its resultant high levels of poverty and extreme social and economic distance between rich and poor continue to manifest in the education of its learners in complex ways. The country provides a somewhat different context for exploring the relationship between SES and education than other countries. The apartheid era only ended in 1994 with our first democratic elections. Education became the vehicle for transforming South African society and a political rhetoric of equity and quality education for all was prioritized. Thus educational deliberations have focused on redressing the inequalities of the past and major curriculum introductions and revisions have been attempted. In this sense engagement with SES and mathematics education became *foregrounded* in policy, political discourses and a range of literature since 1994 although in must be remembered that transformation of education was a priority of the eighties period of resistance and the people's education campaign (although heavily suppressed at the time). Yet for all the political will and prioritization little has been achieved in terms of redressing the inequalities in education.

Much of the recent data available on the relationship between SES and mathematics performance or learning opportunities can be 'mined' from large scale general education reviews that have been commissioned. The reports of these studies tend to provide findings indicating patterns or correlations between school performance and socio-economic context and several indicate that correlations are exacerbated in mathematics. These reports highlight a range of factors or areas that affect learner performance or the crisis in education, such as social disadvantage, teachers' subject knowledge, teaching time, teacher absenteeism, resources, poorly managed schools, poverty effects including malnutrition and HIV/AIDS. In general reports seem to be painting a consistent picture. In South Africa, since poverty affects more than half of our learners, studies tend to focus on the poorest (but largest) SES group when looking at challenges in education. Many reports (e.g. OECD, 2008) point to numeracy scores and mathematics results being consistently below other countries including African neighbours with much less wealth. Additionally this is not always the case for other education areas such as literacy and life skills scores indicating a particular problematic in the area of mathematics. Furthermore, South Africa has the highest levels of between-school performance inequality in mathematics and reading among SACMEQ countries.

What might be somewhat different from several other countries exploring the link between SES and mathematics achievement is that in South Africa poverty levels are extreme even while there is relative economic wealth. Fleisch (2008) argues that poverty must be understood in its full complexity and not simply in economic terms and argues for "the need to understand the underlying structural dimensions of persistent poverty, which engages the complexities of social relations, agency and culture, and subjectivity" (p. 58). He also notes that "Poor families rather than being just a source of social and cultural deficit, are important supporters of educational success…poor South Africans share with the middle class an unqualified faith in the power of education. For poor families education is the way out of poverty, and as such many spend a large portion of their disposable income on school fees, uniforms and transport to get and keep their children in school.” (p. 77)

Mathematics Education research conducted in South Africa almost inevitably touches on issues of equity and redress when engaging with the contextual background of studies. One important area is research on the relationship between language and mathematics education. The overlap between language of learning with SES and mathematics achievement is referred to in almost all of the large quantitative studies above (as a correlating factor) and the data provides for a complex picture that cannot easily be explained in terms of causal relationships. Setati and collaborators (e.g. Setati, 2005; Barwell, Barton and Setati, 2007) urge that multilingualism needs to be reconceptualised as a resource rather than a disadvantage. In this way the deficit discourse around multilingualism and how it negatively correlates with mathematics performance should be reframed. Most language ‘factors’ referred to in the literature above position miltilingualism as a factor that correlates with low mathematics performance but, as suggested earlier, this should not be read as causal.

Recent research by Hoadley (2007) analyses how learners are given differentiated access to school knowledge in mathematics classrooms. She argues that the post-apartheid curriculum with its emphasis on everyday knowledge has had a disempowering effect in marginal groups who are not exposed to more specialised knowledge of mathematics. The result is that “the lower ability student, paradoxically, is left free to be a local individual but a failed mathematics learner” (Muller & Taylor, 2000, p 68). In its implementation teachers in low SES schools struggled to make sense of these changes resulting in even further mathematics learning gaps between ‘advantaged’ and ‘disadvantaged’ learners (Graven, 2002). The result has been that “students in different social-class contexts are given access to different forms of knowledge, that context dependent meanings and everyday knowledge are privileged in the working-class context, and context-independent meanings and school knowledge predominate in the middle class schooling contexts” (Hoadley, 2007, p. 682).

Feza-Piyose (2011) raises questions as to whether “African” students coming into previously “White” schools are given full access to learning. He argues that racism is at the heart of the problem. While racism is a prejudice that must be investigated there are several prejudices that can influence teachers holding low expectations of learners and thus provide learners with differentiated access to learning opportunities. For example, prejudices relating to learners low English language proficiency, learners’ SES or even their health status (e.g. HIV positive) or disability status. I would argue that the whole spectrum of prejudices requires investigation.

As a conclusion, large and small studies relate poverty, class, race and access to English to differentiated learning outcomes from a variety of perspectives. Most, I would argue however, are not sufficiently concerned with the impact of extreme income inequality within a context of widespread and deep absolute poverty. Many poor countries achieve much better educational outcomes compared to South Africa but have lower levels of inequality. Those above the poverty line in South Africa – including teachers – may adopt defensive strategies, often entrenching a *de facto* labour aristocracy and exhibiting hostility to those still poor and unemployed. Whether this is playing out at all in mathematics classrooms, and if so how, (for example through holding low expectations of low SES learners) needs to be explored further. A deeper understanding of inequality as a core component of SES, and not just of the nature and impact of poverty might enrich our understanding of the relationship of SES to mathematical educational outcomes.

Murad Jurdak on A culturally-sensitive equity-in-quality model for mathematics education at the global level

I claim that equity, quality, and cultural relevance are independent dimensions (constructs) in mathematics education. One can easily find situations where there is a high degree of equity but low quality mathematics education or high degree of inequity in high quality math education, or even high equity in quality mathematics education but not necessarily culturally relevant to the community it serves. I refer to this 3-dimensional framework as culturally-sensitive equity-in-quality in mathematics education.

The trajectories of development in the period 1950–2008 of equity and quality in education on one hand and that of mathematics education on the other hand seem to have moved in different directions. The review of literature, particularly that of the United Nations and UNESCO shows that the provision for universal primary education was paramount between 1950 and 2000 and educational quality received low priority during that period. In the first decade of the twenty-first century, quality education for all has emerged as a top priority (UNESCO initiative Education for All). On the other hand, the review of literature of mathematics education shows that the evolution of mathematics education was dominated by quality concerns in scholarly discourse between 1950 and 1980. The social and cultural aspects of mathematics education started to emerge as legitimate research in the 1980s. Towards the end of 1980s, equity issues became a major concern in mathematics education. The first decade of the twenty-first Century witnessed the beginning of convergence towards an increased emphasis on achieving equal access to quality math education. For more details see chapter 2 in Jurdak (2009).

In the last half of the past century, the decline of colonization was a major reason for the emergence of the two-tiered system of mathematics education. During the age of colonization colonized countries, mostly developing countries, adopted the mathematics education of their colonial rulers. However, as colonization started to be dismantled, the developing countries had to invest most of its resources in providing public education to its increasing number of students at the expense of the quality of education and educational research and development. Thus developing countries did not have the chance to accumulate enough 'credentials' in mathematics education to fully participate in the international mathematics education community. This situation led to the formation of a two-tiered system of math education at the global level. The upper tier, referred to as the *optimal mode of development*, includes the developed countries that are integrated in the international mathematics education community. The lower tier, referred to as the *separate mode of development*, consists of the marginalized countries which have yet to be integrated in the international activities of mathematics education.

According to Jurdak (2009), the majority of countries having average or high quality index (measured in terms of national achievement in TIMSS 2003) and low or average inequity index (measured in terms of size of between-school variation) generally fit the optimal mode of development in mathematics education model. These countries have high or average mathematics achievement performance, contribute significantly to international research in mathematics education, and assume leadership roles in international mathematics education organizations and conferences. On the other hand, the majority of countries having low quality index in mathematics education, irrespective of its equity index, fit in the separate mode of development model. These countries have low mathematics performance, have little contribution to international research in mathematics education, and normally have humble participation in international mathematics education conferences, such as the ICME. In other words, they are marginalized by the international mathematical education community and left to follow their own path in developing their mathematics education. Some of these countries, mainly the oil-producing countries, which fit the profile of separate development use the preservation of cultural values as an argument to rationalize the lack of their integration in the international mathematics education community. Other separate development does not have the resources to participate and to contribute to the international mathematics education community.

Jurdak (2011) concluded that a country classified as fitting in the separate mode of development of mathematics education is likely to be relatively poor, low in the spread and level of education among its population, and belongs to a socioeconomically developing region (Arab states, Latin America, and Sub-Saharan Africa). On the other hand, a country classified as following the optimal mode of development of mathematics education is likely to be relatively rich, high in the spread and level of education among its population, and is part of a developed region (North America, Western and Eastern Europe, East Asia and the Pacific).

There seems to be a divide between developing and developed countries in mathematics education, and some of the significant factors that contribute to that divide (socioeconomic status of a country, its educational capital, and its culture) seem to be out of beyond the sphere of influence of local or international mathematics education communities whereas the other factors are not. For example, policies that govern international organizations and conferences (such as using English as the international language in mathematics education and access to international mathematics education literature) may be addressed by the international mathematics education community).

The international mathematics education community has a responsibility to find ways and means to encourage and enable mathematics educators to be integrated in the international mathematics education community. The participation in and contribution to international mathematics education conferences and international mathematics education journals are critical for such integration. One measure in this regard would be to make the policies that govern international mathematics education international organizations more favourable to the participation of mathematics educators from developing countries. Another measure is to broaden efforts to avail resources to promising mathematics educators whose institutions or countries cannot support their travel and accommodation. Writing and presenting in English is a major barrier to the participation of many mathematics educators in international conferences. Mathematics educators who are qualified to engage in international conferences, except for their proficiency in English, would have a better chance of being integrated in the international community if some form of mentoring volunteered by their colleagues who can provide their support in reviewing and editing manuscripts. Providing opportunities for presentations in international conferences in languages other than English by using increasingly more affordable technologies, such as simultaneous translation, would broaden access to such conferences. All these measures may hopefully help enhance the integration of more mathematics educators in the international community.

Danny Martin on Politicizing socioeconomic status and mathematics achievement

Within the United States context, discussions about the relationships between socioeconomic status (SES) and schooling processes and outcomes —persistence, achievement, success, failure, opportunity to learn, access to resources, and so on— are long and enduring. To a large extent, these discussions have surrounded mathematics education —more so than being generated and sustained by mathematics educators— as much of the research and policy generated to support various positions about socioeconomic status has been produced in fields like sociology, economics, critical studies, public policy.

In many of these studies there is often a deficit-oriented narrative that is generated and reified about "poor" children and families, while normalizing certain middle- and upper-class children and families. In the U.S. context, for example, the variable "socioeconomic status" is often used as a proxy for "race" but the discussions, especially in mathematics education, are often unwilling to explore the impact of racism in generating those socioeconomic and achievement differences. This statement is not meant to suggest that race is more important than social class. In my view, the dialectic between the two is important. In fact, a number of dialectics are important with respect to socioeconomic status as one considers the racialized, gendered, and contextual nature of socioeconomic status. The processes undergirding the formation of socioeconomic status and strata in a given historical and political context may help to explain outcomes like school achievement in ways that are more insightful than just placing human bodies into various socioeconomic strata and characterizing their achievement in relation to human bodies in other strata.

In the United States, there have been a handful of recent reports that have attempted to consider race, class, gender, ethnicity, and language proficiency in relation to mathematics education (e.g., Entwisle & Alexander, 1992; Lubienski, 2003; Secada, 1992; Strutchens and Silver, 2000; Tate, 1997). Many of these reports support the intuitive finding that higher socioeconomic status is associated with increased course-taking and higher achievement on various measures of mathematics achievement. However, the story is less clear when one considers that many "Asian" students from the lowest socioeconomic levels in the U.S. outscore White and other students at the highest socioeconomic levels. Moreover, many of these reports leave unexplained high achievement among African American, Latino, and

Native American students, who are disproportionately represented among the lower socioeconomic levels in the U.S.

Again, I would argue that while SES is positively correlated with achievement, mathematics education research in the U.S. context still has far to go in addressing the complexity of these issues. Tate (1997), for example, noted that in defining and operationalizing socioeconomic status, "Typically the mathematics-achievement literature is organized according to a hierarchy of classes—working class, lower-middle class, middle class, and so on. This hierarchy often objectifies high, middle, and low positions on some metric, such as socioeconomic status (SES)" (p. 663). This objectification, in my view, presents socioeconomic status as static and uncontested and not influenced by larger political and ideological forces.

Moreover, there is a great deal of complexity that goes unexplored even within the socioeconomic strata that are used. Again, in the U.S. context, it is generally true that even among poor and working class "Whites" and "Blacks", within-class racism often mitigates the opportunities of Blacks. Across economic strata, the sociology and economics of schooling suggest that "Whites" often enjoy the capital associated with their "Whiteness" even in a supposed meritocracy that many claim and wish for in our society (Jensen, 2006; Roediger, 2005). I would argue that such considerations extend to mathematics education to affect the conditions under which students learn and in which opportunities unfold or are denied.

My particular orientation is to move "race" to a more central position in the conversation on socioeconomic status within the U.S. context (Martin, 2009). However, I do understand that it might be argued that "race" is not a central concern in other national and global regional contexts. I would certainly disagree based on the histories of nationalism, colonialism, xenophobia, anti-Muslim sentiments, and anti-multiculturalism throughout Europe, South America, and other locations. In my view, every context, without exception, experiences a historically contingent "racial" ordering of its society that also structures its socioeconomic ordering. Research on the global contexts of racism(s), in all its forms, make this point very clear for the U.S., Europe, Brazil, Asia, and so on. So, while it may not be an issue of "White" and "Black" in a particular location, there are likely to be some other forms of "race" and "racism" that are at play (including differences that result from "lighter" and "darker" skin), whether they be manifested in the lives of Indians living in Singapore, the ideologies of the Danish People's Party (DF) in Denmark, or the rise of xenophobic nationalism throughout Europe. Quite often, "immigrant" groups and "foreigners" who enter these countries do so at the lowest levels of the economic ladder. It is interesting that when one does a Google Scholar search on "race and "insert any country name", the number of hits is often in the several thousands. This is true even in the context of current global "economic" collapse.

Even acknowledging much of the above, we know that SES does not explain all of the variation in achievement and does not explain why some "poor" or low SES children in a given context succeed academically and why some "rich" or high SES children do less well. Simply put, analyses of SES often treat it as a static variable and often do not examine human agency or the manipulation of SES by those in power. In today's global economy, many people are experiencing a deliberate downward shift in their SES through no fault of their own. Many people who were in the middle and upper strata are drifting toward the lower SES because economic systems are being manipulated to make that happen (i.e., the mortgage and financial crisis; austerity measures in Europe; neoliberal and far-right politics and ideology, etc.).

One major aspect of my argument up to now is that SES is intimately linked to so many other variables that may impact schooling processes and outcomes like achievement. These other variables include gender; geographic location; language status; immigrant status and the prevailing racial context in given society including nationalism, anti-immigrant sentiment, xenophobia; quality of health care and pre-school systems; history of colonialism; the prevailing political context and ideologies that dominate that context; larger economic system; and so on.

I offer the comments above to say that I would argue for a more politicized view of SES that takes into account race and racism, political projects (far-right efforts, neoliberalism, for example), socioeconomic projects and manipulation, and among others. SES may be conceptualized differently in different contexts, but if the common reporting line across regions and parts of the world is "the more economic resources one has, the greater their achievement is likely to be", I do not find that an interesting finding even if it gets repeated in research. It does not explain why some have more resources than others. We, in mathematics education, should continue to trouble that imbalance.

Tamsin Meaney on Back to the future? Mathematics education, early childhood centres[1] and children from low socio-economic backgrounds

In the last two decades, early childhood has become the focus for much discussion in regard to overcoming inequalities in educational outcomes between groups. Although there is a perception that such a connection has only been newly recognised, the history of early childhood centres shows otherwise. For example, May (2001) outlined how preschools in New Zealand have changed dramatically from being charitable organisations for the urban poor in the late nineteenth century to now being seen as essential for all children, to the extent that children who do not attend are perceived as likely to be problems for society. The right to determine the appropriate care for young children through education arose during the history of early childhood centres.

> An activity such as preschool, like most of the welfare institutions, is marked by its history. There is a clear relationship between a country's traditions in preschool and school system and its administration and integration of new challenges and demands. (Broman, 2010, p. 34; own translation)

I suggest that the history of early childhood centres as carers and educators of poor children has produced different sorts of mathematical education programmes. The physical care of

[1] Throughout history and across the world, different names have been given to institutions set up outside of homes for the care and education of young children. To overcome this confusion, the term early childhood centres has been adopted.

young children, who are seen as unable to look after themselves, always has been part of the role of early childhood centres. As well, characteristics of the child, from their character to their imagination, have been perceived as being in need of moral care. Education, including mathematics education programmes, reflected these different perceptions of moral care. Many instigators of early childhood centres have considered that education could overcome faults in children, particularly poor children. Table 1 provides a summary of the main early childhood centres for the last two hundred years and the sorts of moral care and education provided to children.

	Time	Care	Education	Mathematics
Robert Owen – Infants School	Early 19th century	Care of the character.	Broad curriculum.	Arithmetic from manipulating objects from nature.
Frederick Frobel - Kindergarten	1837 to end of 19th century	Spiritual care could only occur in schools.	Playful and based on children's own interests.	Geometry and other mathematical learnt through engagement with gifts and occupations.
Margaret McMillan – Nursery Schools	Early 20th century	Care of the imagination.	Physical and mental development through play.	Mathematics learning was incidental to using their imagination to explore the world.
Maria Montessori – Children's houses	Early 20th century	Care for children's personalities.	Learning though the senses, using children's interests. Preparation for school.	Materials were mathematical in they required comparisons.
Diversity of approaches	Middle to late 20th century	Care for children's psychological well-being.	Learning to play with other children.	Experiences were valuable for later school mathematics learning.
Present day	1990s to present	Care for children's academic	Content becomes the focus of	Mathematical concepts have become the focus

		well-being.	education.	of preschool programs.

Table 1. Summary of the kind of care and education provided in early childhood centres

In recent years, a moral deficiency that early childhood centres are supposed to overcome is a lack of school readiness in regards to mathematics knowledge. An analysis by Greg Duncan and colleagues of six longitudinal studies suggested that early mathematics knowledge is the most powerful predictor of later learning, including the learning of reading (Duncan et al., 2007). The mathematical programmes, now being advocated in early childhood centres, reflect society's wish to care for poor children's academic needs, which are considered to be at risk and which could result in them being non-productive workers in the future (Pence & Hix-Small, 2009). If all children could receive a quality early childhood education then the risk of society having citizens with insufficient education and unable to gain jobs would be alleviated.

A consequence of the acceptance of early childhood centres' right to determine the education necessary to appropriately care for young children is leading to the imposition of a homogenised view of young children, including as young mathematics learners. Providing mathematics programs for this homogenised child can result in a lack of recognition and undervaluing of what poor children bring to early childhood centres. Although the jury is still out on the long-term effectiveness of present structured mathematics programmes (Clements et al, 2011; Barnett, 1995), an education that does not recognise nor value children's transition back into their home communities (Meaney & Lange, 2012 forthcoming) will result in some children becoming failures before they begin school.

Miriam Penteado on Mathematics education and possibilities for the future

The Brazilian educational system is organized in the following way:

Basic school	Primary and secondary level (9 years – from 6 to 14 years old)
	High school level (3 years – from 15 to 18 years old)
Higher education	Different length

Table 2. The Brazilian educational system

For both basic school and the higher education there are two parallel systems: the private and the public. Concerning basic schools, in general, private schools that are privately funded have more status and offer better learning and teaching conditions for students. On the other hand, public schools cater for students, who cannot afford paying their studies, which includes the majority of the Brazilian population. The teaching and learning conditions in public schools is very poor. Many schools are in very bad structural condition and there are cases of no electricity, no potable water, no toilets, etc. It is known that Brazilian public schools students study less content than private schools.

Considering the whole Brazil, there is a huge lack of teachers and in teacher education there is lack of human and material resources. It is more and more difficult to find people who want to be educated as a teacher, and there is a set of reasons for this: low salary, low social status of the teaching profession, and violence in public schools. The best teacher students who graduate are hired by private schools with better working conditions than in public schools.

Concerning higher education the situation is the opposite of what happens in basic schools. *Public universities* are those with the highest investment in research and teaching. In fact, in the last years part of the policy of the Brazilian government has been to increase the investment in higher education making available to the system a considerable amount of resources. It is more difficult to gain enrolment as undergraduate student in public universities than in private, especially in more prestigious courses such as medicine. For this reason, those who attend private schools are more likely to become a student at a public university. Private institutions in higher education, on the other hand, are considered less competitive in terms of educational background. Many students from public school do not even dream of having further education at a public university. The choice (when it is the case) is to work during the day and take a course in the evening at a private faculty.

Considering the status it is possible to state that a person with high socioeconomic background follows the route: from private school to public university. One with low socioeconomic background follows the route: from public school to private faculty. There is financial governmental support for students from public schools to study in private faculties.

Only a small percentage of the Brazilian population has further education at the tertiary level (private or public system). According to the Organisation for Economic Co-operation and Development (OECD)[2] the number of Brazilian people within 25 to 64 years old who has completed tertiary education has increased to 11%. However it is still low when compared with other countries.

As stated, public university receives students with higher socioeconomic status, but inside the university one can find the influence of socioeconomic condition on the students' future careers. As an example, one can use a socio economic report of a public university in Sao Paulo State for the year 2010. The distribution of students in relation to their background (basic school in the private or the public system) in university courses such as medicine and mathematics is very different. While students who enter medicine have studied in private institutions (85,9% of students have attended a private primary school and 94,6% have attended a private high school), the majority of mathematics students have studied primary and high school in public institutions (an average of 72,5 % for public primary schools, and 74,6% for public high schools). This report indicates that the socioeconomics background

[2] http://www.oecd-ilibrary.org/economics/country-statistical-profile-brazil_csp-bra-table-en

has a strong influence on the further education of students. Thus one can see that medicine does not function as any social-ladder, while mathematics has the possibility to do so.

That socioeconomic factors influence students' educational life is common sense. Given this, one could think that there is not so much to say about the survey theme. However, this common sense could be challenged. When working with students in so-called disadvantages context one can consider the question: What possibilities could be constructed together with the students? What opportunities in life could they come to recognise as also being their possibilities?

It is necessary to emphasise that it is important for a mathematics education to create new possibilities for students. Creating possibilities for students could mean thinking of the opportunities they might obtain for, later on, to get a job they would appreciate. It is thought of their future in socio-economic condition in life. One could think as students' possibilities for, later on in life, to participate as (critical) citizens in political issues. To consider conditions for coming to "talking back" to authority, or for becoming "response-able" (able to respond to use a formulation coined by Bill Atweh (2007). One can also consider the conditions for coming to "read and write" the world, to use an expression formulated by Paulo Freire (1972), and further explored by Eric Gutstein (2006).

In what follows it is presented some pictures (see Photos 1-6). Looking at them one can consider the notion of students' achievement. There might exit a tendency to consider low achievement related to the students and to their background. And from this perspective one can start discussing strategies for compensating the, say "low cultural capital". Looking at these pictures, however, one can consider a revision of this whole discourse of achievement. One can simply pay attention to the general living conditions of the students, including their conditions of getting to school. One can consider their learning with reference to their worlds and their foregrounds. The notion of possibility has to do with the notion of students' foreground (Skovmose, 2005). One can claim that it is an important aim for mathematics education to help to establish possibilities within the horizon of students' foregrounds. To make them recognise that: This could also be for me!

OPENING THE RESEARCH TEXTS

During the Spring 2012 a FaceBook group (http://www.facebook.com/groups/310408405684151/) was opened for inviting researchers and teachers to share their view on the topic of the survey. More than summarizing the discussions, we invite colleagues to join the group. Most of the postings allowed a contrast between scholarly research and the readings of the media about differential mathematical achievement in different countries and their educational policies. The growing insistence on mathematics and science performance to maintain the global, competitive economic system overshadows the nuances of practice that both teachers and researchers experience in local settings. The question remains of whether the nuances of practice, where the intersection of multiple positions of disadvantage are evident, have a chance of shaking the commonsense assumptions on how the social and political constitution of mathematics education practices configure the meeting of children with school mathematics.

Fotos 1 to 6. Brazilian students in the State of Amazonas, in the State of Bahia, and in Indigenous schools in the State of Tocantins. Taken from Diez Polanco (2007).

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